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DEVELOPMENT OF NEON TUBE HODOSCOPE CHAMBER AS A DETECTOR OF IONISING PARTICLES

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ABSTRACT. The paper discusses about the construction of a particle detector called the neon tube detector. The details about the processing of the tubes, gas filling and the construction of the chamber as well as the electronics so used has been presented in this paper in a more lucid way. The advantage and disadvantage of this type of detector and the possible cosmic-ray experiments that can be performed with the help of this instrument has also been discussed. A photograph of a single particle, presumably a moun which passes through the chamber and thereby illuminating all the twenty tubes in a column and not the other adjacent tubes has also been presented along with this paper

INTRODUCTION

The neon tube hodoscope chamber has originally been developed by Conversi *et al.* (1955, 1956). After the publication of this short report this detector has been investigated extensively by many investigators ain many countries and now it is used widely in experiments of high-energy and cosmic-ray physics. (Fukui and Miyamoto 1957, Rochester 1960, Coxell and Wolfendale 1961, Hasegawa *et al* 1963).

This neon tube hodoscope has many advantages such as, it is easy to construct at low cost, very stable in operation and short recovery time (about 0.1 second) as well as the life time of the tubes against failure seems to be very long. Due to these facilities this technic is very suitable for the experiment on large cosmic ray showers as well as in the under ground penetrating shower detection.

The major disadvantage of neon tube hodoscope is its limited resolution due to the finite dimension of the tubes and hence the difficulty in interpreting complex events. We present here a preliminary work along this line.

CONSTRUCTIONL FEATURE

In this laboratory a neon tube hodoscope chamber has been constructed with hundred neon flash tubes. This instrument consists of twenty-one aluminium plates placed parallely and between which a number of glass tubes are inserted. Every second plate being electrically connected. Five such tubes are placed in each row. The arrangement used is shown schematically in Fig. 1.

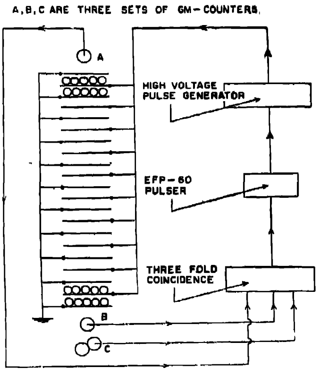

Fig. 1. Schematic diagram of Experimental arrangement.

The tubes are 30 cms long with 1.5 cm in diameter and are made up of Soda Each tube is filled with neon gas at 35 cm Hg pressure. In this experiment spectroscopically pure neon has been used. All the tubes has been washed properly with the cleaning solution (the chromic and sulphuric acid mixture) and are evacuated in electric furnaces. During the experiment all the tubes has been covered with black paper to keep each tube not being illuminated by the light from other tubes.

EXPERIMENTAL ARRANGEMENT AND DISCUSSION

For tests with cosmic rays the chamber is placed between three sets of G. M Counters A, B, and C (as in the diagram shown in Fig. 1). A coincidence between the pulses from the G. M. Counters is made to trigger an EFP60 pulser which in turn fires a 5C22 hydrogen thyratron, applying the high voltage pulse to the chamber. In this test the pulse is derived by discharging a 0.001-μf condenser through a 100-ohm limiting resistor into the chamber. The condenser is charged to a potential of 8KV from a conventional high voltage power supply.

The electric field thus generated inside the chamber is large enough to accelerate the electrons freed by the ionizing particle and cause a luminous discharge in the neon tubes crossed by the paricle and not in the other tubes. Each tube crossed by a particle is set alight and is photographically recorded. A typical photograph of the path of an ionizing particle through the tubes is shown in Fig. 2.

The camera is operated with an $f/8$ aperture, because enough light is generated by the flash and pictures of tracks taken with this f-number are quite satisfactory, using Tri-X Pan film.

The spurious discharges which depend partly on the condition of gases filled in the tubes but mainly on the condition of the inner surface of the glass wall

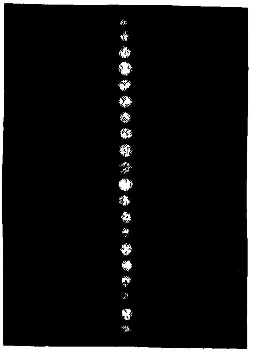

Fig. 2. Photograph of a single penetrating particle.

can be minimised by washing the tubes properly with the cleaning solution and in order to get the best performance it is necessary to get an excellent vacuum before filling.

By the choice of internal diameter of each tube to 2 mm, the spacial resolution of the neon tube hodoscope chamber can be improved to a great extent.

We hope to employ this technic to study an extensive air shower experiment with a larger and more efficient installation.

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